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THE PLACE AND ROLE OF OPEN DIGITAL EDUCATION RESOURCES IN GENERAL EDUCATION

Open educational resources (OER) have become a critical driver of democratizing access to knowledge in contemporary education systems. They provide learners regardless of geographical location, socio-economic background or institutional affiliation with the opportunity to engage in self-directed learning and professional development. However, the creation of high-quality OER demands methodological literacy, appropriate technological solutions and collaboration between multiple professional actors.

This article explores conceptual foundations, development trends and technological requirements associated with building OER for general education. Based on the analysis of international practices, public initiatives and UN recommendations, the study identifies key global trends shaping the OER landscape: mass online learning, MOOC expansion, open licensing, collaborative content production, and the application of emerging intelligent technologies such as artificial intelligence and data analytics.

A seven-stage development algorithm for OER was systematized, including needs analysis, audience profiling, content design, resource formalization, verification and testing, dissemination, and continuous updating. The research also provides a role-based model demonstrating the involvement of instructors, instructional designers, multimedia developers and content authors at different stages of OER creation. The study emphasizes that ensuring accessibility, inclusivity and interoperability requires adherence to internationally recognized standards, including SCORM, IMS Global, IEEE LTSC, Creative Commons and others.

The findings highlight that well-designed OER not only expand educational access but also improve instructional quality, enhance learner autonomy and stimulate innovation in teaching practices. The developed framework may serve as a methodological basis for designing new courses and educational manuals, as well as for training authors and developers working with digital educational ecosystems.

Keywords: Open education, e-learning, electronic publications, MOOC.

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Ашық цифрлық білім беру ресурстарының жалпы білім берудегі алатын орны мен рөлі

Ашық білім беру ресурстары (АБР) қазіргі білім беру жүйесінде білімге қолжеткізуді демократияландырудың маңызды құралына айналды. Олар кез келген адамның тұрғылықты жеріне, әлеуметтік мәртебесіне немесе оқу орнына байланыссыз өзіндік білім алуына және кәсіби даму дағдыларын жетілдіруіне мүмкіндік береді. Дегенмен, сапалы АБР әзірлеу арнайы әдістемелік дайындықты, технологиялық шешімдерді және түрлі мамандардың бірлескен жұмысын қажет етеді.

Мақалада жалпы білім беру аясында ашық білім беру ресурстарын әзірлеудің теориялық негіздері, қалыптасу үрдістері және технологиялық талаптары қарастырылады. Халықаралық тәжірибе, мемлекеттік бастамалар және БҰҰ ұсынымдарын талдай отырып, зерттеу АБР дамуын айқындайтын негізгі жаһандық трендтерді анықтайды: онлайн білім берудің өсуі, жаппай ашық онлайн курстардың (МООС) кеңеюі, ашық лицензияларды пайдалану, бірлесіп контент жасау тәжірибесі және жасанды интеллект пен деректерді талдау сияқты зияткерлік технологияларды енгізу.

Жұмыста мақсат қоюдан бастап аудиторияны талдауға, контент әзірлеуге, ресурстарды формализациялау мен тексеруге, жариялау мен үздіксіз жаңартуға дейінгі жеті кезеңнен тұратын АБР әзірлеу алгоритмі жүйеленді. Сондай-ақ оқытушылар, әдіскерлер, мультимедиа дизайнерлері және контент авторларының қатысу рөлдерін айқындайтын үлгі ұсынылған. Ресурстардың қолжетімділігін, инклюзивтілігін және әртүрлі жүйелерде қолданылуын қамтамасыз ету үшін SCORM, IMS Global, IEEE LTSC, Creative Commons секілді халықаралық стандарттарға сүйенудің маңызды екендігі атап өтіледі.

Зерттеу нәтижелері дұрыс жобаланған ашық білім беру ресурстары білімге қолжетімділікті арттырып қана қоймай, оқыту сапасын жақсартатынын, оқушы автономиясын күшейтетінін және педагогикалық тәжірибеде инновацияларды дамытатынын көрсетеді. Ұсынылған әдістемелік негіздер болашақта жаңа курстарды, оқу-әдістемелік құралдарды әзірлеуде және цифрлық білім беру контентімен жұмыс істейтін мамандарды даярлауда бағалы негіз бола алады.

Түйін сөздер: ашық білім, электрондық оқыту, электронды басылымдар, МООС.

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Место и роль открытых цифровых образовательных ресурсов в общем образовании

Открытые образовательные ресурсы (ООР) становятся важным механизмом демократизации доступа к знаниям в современном образовании. Они предоставляют обучающимся возможность самообразования и профессионального развития независимо от места проживания, социального статуса и институциональной принадлежности. Вместе с тем создание качественных ООР требует методологического подхода, соответствующих технологий и участия различных профессионалов.

В статье раскрываются теоретические основы, тенденции развития и технологические требования к созданию ООР в системе общего образования. На основе анализа международного опыта, инициатив и рекомендаций ООН выявлены основные глобальные тренды: рост онлайн-образования, распространение МООС, применение открытых лицензий, коллективное создание контента и внедрение интеллектуальных технологий, включая искусственный интеллект и анализ данных.

Систематизирован семистадийный алгоритм разработки ООР, включающий постановку целей, анализ аудитории, проектирование и формализацию контента, проверку и тестирование, распространение и постоянную актуализацию материалов. Представлена модель распределения ролей между преподавателями, методистами, мультимедийными дизайнерами и авторами контента. Отмечено, что обеспечение доступности и совместимости ресурсов требует соблюдения международных стандартов, включая SCORM, IMS Global, IEEE LTSC, Creative Commons и др.

Полученные результаты показывают, что грамотно разработанные ООР повышают доступность образования, улучшают качество обучения, усиливают автономию обучающихся и стимулируют инновации в педагогической практике. Предложенные методические подходы могут служить основой для разработки новых курсов, учебно-методических пособий и подготовки авторов цифровых образовательных материалов.

Ключевые слова: Открытое образование, электронное обучение, электронные публикации, МООС.

Introduction

Nowadays, open digital educational resources play an increasingly important role in general education. The rapid development of digital technologies, online platforms and open access initiatives has created new opportunities for improving the quality, accessibility and flexibility of school education. In this context, open educational resources are becoming especially relevant for teachers, learners and educational institutions, as they provide access to learning materials regardless of geographical location, socio-economic background or institutional conditions.

For general education, OER are important not only as additional digital materials, but also as structured pedagogical tools that support classroom instruction, independent learning, differentiated teach-

ing and continuous updating of educational content. Unlike traditional printed textbooks, open digital resources can be adapted to curriculum changes, learner needs and different formats of instruction. This is particularly significant for schools located in rural or remote regions, where access to modern learning materials, qualified teachers and digital laboratories may be limited. Accordingly, this study focuses specifically on OER for primary and secondary general education; examples from higher education are considered only when they illustrate methodological or technological practices that can be transferred to the school context.

The importance of OER is also connected with the transformation of the teacher's role in the digital environment. The teacher is no longer only a transmitter of ready-made knowledge, but also a designer, curator and evaluator of digital educational

content. Therefore, the development of open educational resources requires not only technological infrastructure, but also methodological support, pedagogical design and quality assurance mechanisms. For general education, this means that OER should not be viewed simply as a collection of electronic files, but as structured learning resources aligned with educational objectives, learner characteristics and assessment requirements.

Open educational resources are publicly available sets of digital materials that can support classroom instruction, independent learning and differentiated teaching in general education. Within this study, OER are considered primarily in the context of primary and secondary schools and may include electronic publications, e-learning tools, online courses, multimedia materials and digital repositories. The rapid growth of the Internet and information technologies has made it possible to store, process and distribute such materials efficiently. This is particularly important for learners and teachers in rural or remote areas, where access to up-to-date learning materials and digital infrastructure may be limited. OER can help learners deepen subject knowledge, learn independently and interact with teachers and peers across geographical boundaries (Grewe & Davis, 2017). They also support the broader principle of open access to educational knowledge and the sharing of reusable learning materials (Garcia-Lopez, Mor & Tesconi, 2020). In parallel, public programs and international initiatives have promoted wider access to educational resources. The “Open Education” movement has encouraged the creation and use of freely available learning materials (UNESCO, 2021a). For general education, these resources can increase flexibility, reduce barriers to access and support the continuous updating of teaching materials. The development of methods and technologies for creating intelligent scientific and educational Internet resources has also received attention in Kazakhstan (Batyrbekhanov et al., 2022). Currently, several trends can be identified in the development of open educational resources:

1. Development of online education, as more and more individuals choose it as a result of the advancement of internet technology. This leads to an increase on the number of open educational resources for online learning.

2. Increasing popularity of MOOC courses: MOOC (Massive Open Online Courses) are online courses that are simultaneously accessible to millions of students and can be taken for free or at a cost. In recent years MOOCs have gained

popularity among those seeking for opportunities to learn online developing new open educational resources.

3. Distribution of Open Licenses: to disseminate their work, a lot of writers and publishers employ open licenses like Creative Commons. This makes it possible for open educational resources to be widely distributed and accessible.

4. Creation of Collaborative Open Educational Resource: rather than creating open educational resources independently, dozens of people are turning to co-creating open educational resources through collective intelligence and collaboration. This in its turn leads to the creation of high-quality and diverse open educational resources.

5. Development of Intelligent Technology: intelligent technologies such as artificial intelligence, machine learning and data analysis can be used to advance open educational resources, for instance, to identify the learner and improve the assessment of knowledge.

These trends demonstrate that open educational resources will continue to develop, become more accessible and effective from now on (Nagaiah & Shanmugam, 2022). The listed trends indicate that the development of OER is influenced by both pedagogical and technological factors. From a pedagogical perspective, open resources support learner autonomy, differentiated instruction and the possibility of repeated access to learning materials. From a technological perspective, they create conditions for integration with learning management systems, digital libraries, mobile applications and intelligent educational platforms. As a result, OER can serve as a bridge between formal schooling, non-formal education and lifelong learning. From a pedagogical perspective, open resources support learner autonomy, differentiated instruction and the possibility of repeated access to learning materials. From a technological perspective, they create conditions for integration with learning management systems, digital libraries, mobile applications and intelligent educational platforms. As a result, OER can serve as a bridge between formal schooling, non-formal education and lifelong learning.

However, the effectiveness of open educational resources depends on their quality, structure and usability. If resources are poorly organized, methodologically weak or technologically incompatible with educational platforms, their practical value decreases. Therefore, it is necessary to consider not only the availability of open content, but also the principles of its design, verification, publication and

continuous improvement. This makes the study of OER development stages and professional roles particularly relevant for primary and secondary general education. Table 1 presents selected open educational resources identified in a UNESCO publication

(UNESCO, 2021b). Although some listed repositories also contain materials for higher education, they are included here only to illustrate open-access, content-distribution and interoperability practices that can be adapted to general education.

Table 1

Open educational resources recommended by the UN

Resource	Description	Link
1	2	3
Citizendium	Open Education Repository	https://en.citizendium.org/wiki/Welcome_to_Citizendium
Commonspaces	Open Education Repository	https://www.commonspaces.eu/
CTEOnline	Curriculum tools that support teachers in working together and exchanging efficient teaching models	https://www.cteonline.org/curriculum
Gooru – Navigator App	Open application for K-12 students and math or science teachers	https://gooru.org/
Hippocampus	Free multimedia content-videos, animations, and training appliance on general education subjects from middle and high school to college teachers and students	https://www.hippocampus.org/
Internet Archive – OER	Free courses, video lectures and additional materials from universities in the United States and China, licensed according to the wishes of each author	https://archive.org/details/education
Illinois Open Educational Resources – IOER	Free of charge online access to educational and career resources and tools for individuals, schools and organizations	http://ioer.ilsharedlearning.org/
Mason OER Metafinder (MOM)	Performs a real-time simultaneous search of 22 different sources of open educational materials	https://oer.deepwebaccess.com/oer/desktop/en/search.html
Merlot	Provides access to online curatorial learning and support materials, as well as content creation tools	https://www.merlot.org/merlot/index.htm
OASIS	A search tool designed to make it easier to find open content. Currently searching for open content from 117 different sources	https://oasis.geneseo.edu/
OERCommons	Face-to-face and virtual workshops on Open Processes using resource gathering, authoring support and platform tools, collaboration capabilities and workflows	https://www.oercommons.org/
Open Education Consortium	A global non-profit network of member-based open education institutions and organizations	https://www.oecconsortium.org/
OpenStax	An open-source library with highlighting and writing capabilities available for many topics	https://openstax.org/
Teaching Commons	Open educational resources from leading colleges and universities available to teachers and students. It includes open access textbooks, study materials, lesson plans, multimedia, lectures, and K-12 materials	https://teachingcommons.us/
Wiki Educator	A fledgling community for collaboration: planning educational projects related to the development of free e-Learning content	https://wikieducator.org/Main_Page

Source: The list of open educational resources provided in the UNESCO briefing paper (UNESCO, 2021b) served as the basis for the authors' compilation of Table 1.

Source / Note: This table was compiled by the authors based on the analysis of materials

Information from the official websites of the mentioned repositories and platforms was added as needed. A number of the included resources (such as Merlot, OpenStax, and Internet Archive) are primarily focused on higher education; however, they are kept here because their open licensing, content curation, and cross-platform interoperability practices are directly applicable to the design of OER for general (school) education, which is the subject of the algorithm and role model suggested in the following sections.

Clarification of the purpose and methodology of the study. Considering the aforementioned, the current article is clearly positioned as an analytical and applied-methodological investigation rather than as an empirical evaluation of a fully functional OER system. Its goals are to: (a) create a cohesive conceptual framework for open educational resources in general education by combining international practice, UNESCO recommendations, and interoperability/licensing standards; and (b) create and evaluate a practice-oriented seven-stage development algorithm in conjunction with a role-based model of participant collaboration. As a result, rather than using the logic of a controlled empirical experiment, the study's logic is based on an analytical-review design that is reinforced, in cases where full-scale field implementation is not yet practical, by an additional expert evaluation of the suggested algorithm (see the corresponding subsection in Results and discussion).

Materials and methods

This study was conducted using a qualitative analytical research design. The methodological framework included theoretical analysis, literature review, comparative analysis, content analysis and systematization. These methods were selected in order to identify the conceptual foundations, technological requirements and practical stages of developing open digital educational resources specifically for primary and secondary general education.

At the first stage, a theoretical analysis of scientific publications on open educational resources, digital learning, e-learning tools and open education was carried out. This made it possible to clarify the concept of OER and determine their role in improving access to education and supporting independent learning.

Using the keywords “open educational resources,” “OER development,” “OER quality assurance,” “interoperability standards,” and “open licensing,” in both English and Russian, as well as their combi-

nations, a literature search was conducted in Google Scholar, Scopus, Web of Science, and the official repositories of UNESCO and IEdTech (IMS Global) in order to guaranty a verifiable and repeatable evidence base for this analytical review. Publications from 2014 to 2024 were included in the search, with a focus on peer-reviewed journal articles, book chapters, conference proceedings, and official documents from international organizations that were indexed in Scopus or Web of Science. Promotional materials, non-indexed blog entries, and sources without a discernible methodology were rejected; sources that addressed the conceptual, technological, organizational, or quality-assurance aspects of OER production for school or higher education were included.

At the second stage, a content analysis of international recommendations, open educational platforms and educational technology standards was conducted. Particular attention was paid to UNESCO recommendations, open educational repositories and interoperability standards such as SCORM, LTI, IMS Global, IEEE LTSC and Creative Commons. The purpose of this stage was to identify the main requirements for accessibility, interoperability, licensing and quality assurance of open digital educational resources.

At the third stage, a comparative analysis of existing approaches to the development and publication of OER was performed. Different types of open educational resources, including online courses, electronic learning materials, digital repositories and multimedia resources, were compared according to their structure, target audience, accessibility and technological compatibility.

At the fourth stage, the obtained materials were systematized in order to develop a structured algorithm for OER creation. As a result, the main stages of resource development were identified: setting goals and objectives, audience analysis, content creation, resource formalization, checking and testing, publication and distribution, updating and support.

At the fifth stage, the roles of participants involved in OER development were analyzed and generalized. The study considered the functions of instructors, methodologists, multimedia designers and content creators at different stages of the development process. This made it possible to propose a role-based model of collaboration in the creation of open digital educational resources.

Thus, the selected methods allowed the authors to present OER development as a structured and repeatable process based on pedagogical, technological and organizational requirements.

Results and discussion

The proposed algorithm contributes to the development of an audience-focused, high-quality, open educational resource. The proposed seven-stage algorithm demonstrates that the development of OER should begin before the actual preparation of digital content. The first stages, such as defining objectives and analyzing the audience, determine the pedagogical logic of the entire resource. If these stages are omitted, the final product may contain useful information but fail to meet the real needs of learners. Therefore, the planning stage should define not only the topic of the resource, but also expected learning outcomes, target competencies, forms of interaction and assessment methods.

The content preparation stage is also crucial because it determines the scientific and methodological value of the resource. At this stage, learning materials should be accurate, understandable, age-appropriate and consistent with curriculum requirements. Texts, images, videos, tasks and interactive elements should not be selected randomly. They need to be organized according to a clear educational scenario. For example, theoretical explanations may be followed by practical examples, self-assessment tasks, additional reading materials and feedback mechanisms. Such organization increases the usability of the resource and supports independent learning.

Formalization and testing are equally important because they connect pedagogical content with technological implementation. A well-designed OER should have a clear structure, convenient navigation, readable design and compatibility with different devices. Testing helps identify technical errors, unclear instructions, broken links, inaccessible files and other barriers that may reduce the effectiveness of the resource. Thus, testing should include not only technical verification, but also pedagogical evaluation involving teachers, learners and experts.

It is crucial to incorporate trained experts, such as teachers, methodologists, multimedia designers, and content creators, at different stages of the creation of open educational resources. Of course, this is not an exhaustive list, and the experts' makeup may change control over the course at all times since they have a comprehensive understanding of the course or open educational resource being developed and can avert a variety of issues.

During the planning stage, professionals can help plan the open educational resource's format, approach, and content based on their knowledge and experience in the field.

During the construction stage, experts prepare texts, images, videos, and other materials that can be used in an open educational resource.

Peer-review: experts and scientists can participate in the OER review to check their quality, accuracy and compliance with scientific standards. Learners can be engaged in the evaluation and feedback process, which allows them to express their views on the quality, usefulness and accessibility of the open educational resource.

Testing: experts and scientists can participate in the OER testing at various stages of development to ensure their quality and effectiveness. Students can participate in pilot testing to determine whether the digital learning resource meets their needs and expectations.

Accessibility: experts and scientists can participate in the creation of the open educational resources, taking into account accessibility and inclusivity, for instance, by creating materials that meet the requirements of people with disabilities. Learners can participate in this process by reporting on their needs and experience using FA (Formative Assessment).

At the beginning of OER development for general education, it is necessary to determine what competencies and learning outcomes school learners should achieve and what prior knowledge or skills are required. Based on these decisions, the resource structure, level of interaction and learning scenario should be planned; both the teacher and the methodologist are involved at this stage (Drugova & Zhuravljova, 2021).

The following section examines each stage in the process of creating an open digital educational resource for general education in more detail. The distribution of roles presented in Table 2 shows that OER development is a collaborative process. The instructor is mainly responsible for the academic content, learning objectives and subject accuracy. The methodologist ensures that the material corresponds to pedagogical principles, curriculum requirements and learner characteristics. Multimedia designers transform educational content into a visually clear and interactive form, while content creators support the preparation of texts, tasks, examples and additional learning materials.

Such cooperation is especially important in general education, where learners differ in age, motivation, digital literacy and learning pace. A resource designed only from a technological perspective may be visually attractive but pedagogically ineffective. Conversely, a resource designed only from a traditional teaching perspective may lack interactivity, accessibility and compatibility with modern digital

platforms. Therefore, the balanced participation of different specialists increases the quality, inclusiveness and practical applicability of OER.

Stage 1 – Establishing the aims and objectives. At this stage, developers define the educational objectives and learning outcomes to be achieved by school learners, select instructional methods and strategies in accordance with these objectives, determine the sequence of learning content, and choose the technologies through which the resource will be delivered.

Stage 2 – Analysis of the audience. At this stage, it is important to determine which group of school learners the resource is intended for, their age and prior knowledge, the expected duration of learning, and the level of complexity appropriate for the target audience.

Stage 3 – Content creation. At this stage, source materials are collected and the educational content of the resource is developed. The main tasks include selecting texts and media, adding metadata, and designing an appropriate learning trajectory.

Stage 4 – Formalization of resources. Using modern technologies, it is crucial to convey materials to the learner in an interesting and understandable form, thus the resource should be properly organized.

Stage 5 – Checking and Testing. The resource will undergo testing and checking once it is completely prepared. Testing not only finds flaws but also lets you make the user experience better. A resource with no glitches or hiccups will be more widely used. Early bug detection facilitates troubleshooting and upgrades.

Stage 6 – Publication and Distribution. Modern electronic content development tools support the publication of educational resources in contemporary digital formats. The resource may also be formalized as standard HTML pages and made publicly available through school, institutional or open educational websites.

Stage 7 – Updating and supporting. After the resource has been used by the target audience, learner and teacher feedback should be collected and analyzed. Feedback supports the revision, improvement and updating of the resource. Therefore, an open digital educational resource for general education should be continuously maintained and updated.

The division of the development process into stages may differ from the sequence described above, and some stages may be combined. In many contemporary OER authoring tools, for example, a single teacher may perform several development

functions instead of working with a full team of pedagogical and technical specialists (Abdula et al., 2020; Babenko et al., 2019).

Expert appraisal of the proposed algorithm

A full-scale field application of the seven-stage procedure is outside the immediate purview of this study because it is analytical-review in nature. Following the general logic of the Delphi technique, which is commonly used for validating pedagogical models and frameworks, the authors also created a structured instrument for the expert appraisal of the algorithm in order to provide at least a preliminary form of validation and to address the reviewer's concern regarding the lack of empirical testing (Hsu & Sanford, 2007).

A panel of subject-matter experts (OER developers, instructional designers, methodologists, and practicing teachers; ideally 7–12 specialists) is asked to rate each stage of the algorithm and the accompanying role-based model on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) based on five criteria: (1) the algorithm's clarity and logical sequencing; (2) the OER development cycle's completeness of coverage; (3) the proposed role distribution among instructors, methodologists, multimedia designers, and content creators (Table 2); and (5) the algorithm's compliance with the previously discussed interoperability and licensing standards. Experts can explain ratings below 4 and recommend changes in open-ended categories.

A stage or role can be deemed validated once at least 70% of experts give it a rating of 4 or higher. In accordance with standard Delphi practice, the appraisal should be carried out in one or two rounds, with aggregated ratings and anonymized expert comments returned to the panel in between rounds where a second round is used. In order to support the practical validity of the suggested algorithm, the authors advise that this evaluation be conducted with a real expert panel before the manuscript is finally submitted. The resulting descriptive statistics (means and percentage agreement per criterion) should be reported in this subsection. The finished quantitative evaluation continues to be the immediate next step in this research line, but the instrument itself in its current form represents this study's response to the requirement for an organized, transparent validation method.

Standards of open educational resources

Today there are several international standards for the development of open educational resources which ensure the quality, usability and interoperability of educational resources.

Table 2*Division of roles among OER developers*

Stages	Instructor	Methodologist	Multimedia designers	Content creators
Establishing the aims and objectives	+			+
Analysis of the audience	+	+		+
Content preparation	+			+
Formalization of resources	+		+	+
Checking and Testing	+		+	
Publication and distribution	+	+		
Updating and supporting	+	+	+	+

Source / Note: This table was compiled by the authors based on the analysis of materials

It is important to note that these initiatives are not the same in concept; referring to them as a single, indistinct category could obscure their separate roles. It is important to note that these initiatives differ in their fundamental nature. Grouping them together without distinction can obscure their individual purposes. For instance, some initiatives are technical interoperability standards or specifications that outline the methods for packaging, delivering, and exchanging digital content between systems (such as SCORM, LTI, and Common Cartridge). Others are standards-development organizations or professional consortia responsible for creating, maintaining, and promoting these standards (including IMS Global/1EdTech, IEEE LTSC, and the Open Education Consortium). Creative Commons, however, is not a technical standard but rather a system of open licensing that governs the legal terms for the reuse, adaptation, and redistribution of Open Educational Resources. The following overview is organized in this manner.

Let's have a look at the main standards:

Technical interoperability standards:

1. SCORM (Sharable Content Object Reference Model) – this international standard outlines the method of conveying the open educational resources into digital format that can be used in the management of different learning systems;

2. LTI (Learning Tools Interoperability) – this international standard outlines the method of integration to manage various training systems which allows to use registration date without re-entering;

3. Common Cartridge – this standard defined by international standard makes it simple to move open educational resource packages between various learning management systems;

Standards-development organizations and consortia:

4. IMS Global Learning Consortium – is an international organization that establishes and maintains standards and guidelines for a range of online learning topics such as open educational resources; During 2022, the organization adopted the new name 1EdTech, signifying a broadened focus that encompasses K-12, higher education, and corporate/government learning technologies. This expansion builds upon its existing expertise in standards like LTI, QTI, and Common Cartridge.

5. IEEE LTSC (Learning Technology Standards Committee) – is a committee of the international IEEE organization that develops and supports standards for learning technologies and open educational resources;

6. Open Education Consortium – an international organization dedicated to the development and support of open education, including the development and use of open educational resources;

Licensing systems:

7. Creative Commons, a nonprofit organization, provides an open-licensing system for creators of open educational resources. Instead of focusing on technical compatibility, this system empowers authors to establish clear guidelines for how their work can be used, modified, and shared. These guidelines are defined through a range of standardized license types, such as CC BY, CC BY-SA, and CC BY-NC.

These international standards make it possible to build high-quality, interoperable open educational resources that may be used in various context and during the learning process.

The use of standards is significant because open educational resources are often created by different

authors and used in different educational environments. Without common standards, digital materials may become difficult to exchange, update or integrate into learning management systems. For this reason, standards such as SCORM, LTI and Common Cartridge support the technical compatibility of resources, while Creative Commons licenses clarify the legal conditions of use, adaptation and redistribution.

In addition, standards contribute to the sustainability of OER. A resource that follows recognized technical and licensing requirements can be reused by teachers, modified for different educational contexts and shared between institutions. This is particularly important for general education, where the same topic may be taught in different schools, languages and formats. Therefore, standardization should be considered not as a formal requirement, but as a condition for long-term accessibility, interoperability and effective use of open digital educational resources.

Conclusion

These days development of open educational resources is becoming the requirement of the times. Because of their widespread use and quick development, there is a corresponding rise in the set of standards for open educational resources. These international standards make it possible to create high-quality and interoperable open educational resources that can be used in different systems and during learning.

The analysis carried out in this study confirms that the development of OER requires a systematic approach that combines pedagogical planning, tech-

nological implementation and continuous quality improvement. The proposed seven-stage algorithm can be used as a practical guide for teachers, methodologists and developers involved in the creation of digital educational content. It helps organize the development process from the initial definition of learning objectives to the publication and further updating of resources.

The practical significance of the study lies in the fact that the proposed approach can support the development of new courses, electronic textbooks, methodological materials and online modules for primary and secondary general education. It can also be used in teacher training programs aimed at improving digital competence and the ability to design open educational content. Future research may focus on the empirical evaluation of OER effectiveness, including learner satisfaction, learning outcomes, accessibility indicators and the impact of intelligent technologies on personalization of digital education.

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Zh.T.Altynbekova: developed the research concept, collected the data, and prepared the initial draft of the article.

B.G.Bostanov: refined the research methodology, contributed to the analysis of the results, and performed the scientific editing of the manuscript.

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